



UTS: INSTITUTE FOR SUSTAINABLE FUTURES AND CSIRO  
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# Meta learning from past adaptation

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## EXECUTIVE SUMMARY

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The purpose of this technical paper is to review past adaptation activities and distil lessons from these for next generation adaptation initiatives. Specifically, we review the range of adaptation activities currently and recently undertaken within NSW, as well as informative examples worldwide. This review was designed to follow on from the sister report, Kuruppu & Jacobs (2014 “*Climate adaptation pathways: Resilience, Transition and Transformation*”).

The aims of this paper are:

1. What are existing adaptation initiatives that have been implemented to support communities in NSW or in Australia in general? What conditions gave rise to successful adaptation implementation? How was success defined and by whom?
2. What are the gaps in knowledge in this area and can we examine them through the NSW adaptation hub? What are the implications of these findings for NSW adaptation policymakers? What design considerations are relevant for case studies?

A series of key issues were identified that have been drawn from the literature, which are relevant for NSW in designing adaptation approaches. The key adaptation principles are:

- Importance of local scale and other scales – Local government is crucial for on-ground adaptation, but needs to be effectively linked to national scale issues.
- Importance of deliberative processes and multiple partnerships – Multiple partnerships are necessary to manage multiple drivers, and new partnerships are needed between government, science, private sector and local communities to support local adaptation. A range of deliberative processes are needed to engage effectively. Leadership needs to be strong, and sufficient resources are required.
- Managing “climate change” versus specific events – There is a danger that the agenda gets side-tracked if the emphasis is on “climate change” alone. An alternate approach is to focus on specific events or issues that are locally relevant.
- Lack of information – Limited information about vulnerability of municipalities to climate impacts can be a constraint. The degree of information needed for adapting to climate change depends on the type of response in focus and needs to be relevant.
- Institutional limitations, resource constraints and competing agendas – The ability of local institutions to adapt to climate change concerns the policy framework in which local government operates, their financial capacity and competition for finite resources. Policy makers need to be aware of potential mismatches between current organisational roles and scale of adaptation and institutional support.

A recent NCCARF review identified the following principles of ‘good adaptation’ and largely follow the findings of this review:

- Sustained and effective leadership
- Effective stakeholder engagement
- Maintaining a balance of social, economic, environmental and institutional objectives
- Learning from experience of other adaptation initiatives
- Following adaptive management approaches including evaluation and social learning
- Explicit framing of adaptation issues agreed up front
- Addressing multiple spatial and temporal scales together

- Taking a systems approach to climate risks
- Evaluating adaptation options most relevant to support decision making
- Articulating a clear statement of adaptation vision
- Carefully choosing appropriate methods for relevant issues

Four case studies are presented of relevance to NSW. These case studies demonstrate:

1. Emphasis on working across regional groups of local councils, peak entities and accessing resources from higher levels of government.
2. Vulnerability assessments as an important mechanism for advancing adaptation and that high levels of community engagement, leadership and collaboration with neighbours are recognised strategies for overcoming adaptation barriers.
3. Importance of seeking feedback from local council staff and involving stakeholders in assessments to increase social acceptance and legitimising the outcomes.
4. Integrated Assessments are flexible and context-specific approach that allows a greater focus on participation and enabling communities to develop their own localised adaptation options, but need sufficient resourcing.

The key lessons from recent adaptation practice indicate that:

1. Local councils are key agencies but need support from higher levels of government.
2. Adaptation actions have occurred mostly at the local scale where climate impacts are experienced.
3. Support is needed in terms of training, legislative recognition and financial resources. Training is crucial to underpin effective leadership and provide the institutional support required for adaptation to advance.

A range of challenges in monitoring and assessing (M&E) adaptation are presented, which reflect issues around long timeframes, uncertainties, measuring avoided impacts, relevance of data at different scales, assessing attribution versus contribution, M&E approaches, and issues around “maladaptation”. Because of these problems climate change is often considered a “superwicked” problem, an alternative “weak” policy approach is suggested, drawing on lessons learned in Europe.

# 1 CONDITIONS THAT GAVE RISE TO SUCCESSFUL ADAPTATION

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Distilling the lessons from the 'early adopters' is a crucial source of insight for advancing wider uptake of climate adaptation. For those who have already been exposed to adaptation practice in NSW, the following section will have many familiar observations, along with some new insights drawing on the latest international literature up until early 2014. Moreover, for those who have had less experience with adaptation in NSW, the review will provide a useful overview of past lessons and current insights drawing on local and international contexts.

## 1.1 IMPORTANCE OF LOCAL SCALE AND OTHER SCALES

The role of local governments, often acting together across local boundaries, has emerged as a crucial interface for climate adaptation (Measham *et al.*, 2011; Baker *et al.* 2012; Matthews 2012; Mukheibir *et al.* 2012). The local scale has emerged to be crucial for climate adaptation. This is principally because the impacts of climate change are most readily experienced locally, and therefore, geographic variability in climate impacts emphasises the need for local or regional approaches to climate adaption (Adger and Kelly 1999; Cutter *et al.* 2000; Turner *et al.* 2003). Although the drivers of climate adaptation are predominantly global, they manifest themselves in particular ways at the local scale (Walker *et al.* 2002; Turner *et al.* 2003). Local government is one of the main responsible entities for managing climate impacts, such as floods, often in collaboration with State governments where State emergencies have been declared. In addition to responding to particular events, local governments also have a role in mediating between individual and collective responses to vulnerability; and managing vulnerability through planning initiatives and infrastructure maintenance and development to reduce the severity of future impacts (Agrawal 2008). A final reason to focus on the local scale and partnerships between local and State governments is a perceived lack of progress at international and national scales in many countries, such that the institutions which experience the impacts of climate change at the local to regional scale are motivated to take the initiative in terms of progressing adaptation.

Where national governments have invested in climate adaptation, this has often taken the form of supporting local and regional responses, hence adding to the tendency to think 'adaptation is local' (Measham *et al.* 2011). Other international mechanisms to support adaptation have also focused on the local scale, notably the International Council for Local Environmental Initiatives (ICLEI), which has engaged in developing adaptation guidance and practice in a range of global regions including North America and Oceania with a particular emphasis on urban areas (Snover *et al.* 2007; ICELI Oceania 2008; ICLEI Canada 2010).

Even though the local scale has emerged as crucial for achieving adaptation, it is important to emphasise that this scale of government is dependent on higher scales of governance for resources (Hajer 2003; Hajer and Versteeg 2005). Moreover, Local government already has a crowded agenda in terms of managing local infrastructure and delivering a wide range of local services (Wild River 2006; Pini *et al.* 2007). There is evidence from several countries that the mandate of local governments is expanding as they adopt increasing roles on behalf of higher levels of government (Repetto 2008; Ford *et al.* 2011; Berrang-Ford *et al.* 2011; Preston *et al.* 2011), providing they are sufficiently resourced to do so. For these reasons, adaptation at the local scale needs to be viewed in terms of partnerships across institutions at the local scale and with higher scales of government (Amundsen *et al.* 2010; Taylor *et al.* 2013). Sharing experiences across municipalities has been identified as a key approach to support local governments (Giest & Howlett, 2013), but needs support from higher levels of government to be successful.

Another aspect of scale is to consider temporal dimensions. For example, uncertainty can be explored as a time frame, and a point in which a critical threshold is likely to be exceeded (Werners *et al.* 2013). This threshold is the point where existing policy is untenable and alternative strategies must be considered. Werners *et al.* (2013) looked at multi-scale adaptation attributable to climate change and other factors. One key finding was that it was important to encourage short-term actions to sustain current system, whilst keep longer term activities open.

## 1.2 IMPORTANCE OF DELIBERATIVE PROCESSES AND MULTIPLE PARTNERSHIPS

Deliberative processes, multiple partnerships and social learning are all approaches designed to bring a wide range of perspectives together in a relatively rigorous process and to build mutual understanding and trust. New multiple partnerships have been identified by Bryan *et al.* (2013) to manage multiple drivers. New partnerships and approaches are required, which can:

- foster new partnerships between government, science, the private sector, and local communities to support local adaptation;
- identify critical environmental limits and rationalizing environmental laws;
- establish innovative social processes and adaptive governance; and
- develop innovative, well-supported market based and community-based incentives.

Glavovic (2013) described a framework for community deliberations for coastal communities to manage coastal areas being impacted by climate change, but it needs testing in different situations. The key components are to build human and social capital through issue learning and improved democratic attitudes and skills, then to facilitate community-oriented action and improve institutional capacity and decision-making. The local cultural context also is important, so needs careful and textured study of cultural systems. The amount of collective action at a community level is dependent on existing social networks (Lyon *et al.* 2013). Adger *et al.* (2012) also emphasised the importance of cultural dimensions in how people respond to climate change. They highlight that it will be difficult to incorporate multiple and marginalised voices and plural voices into robust and



replicable decision-making, but it was considered important to recognise diverse perspectives and promoting decision-making at appropriate and often multiple scales.

Interactions between different actors are necessary to help identify problems and solutions. McCormick *et al.* (2013) encouraged interactions between researchers and universities to shape research and innovation activities (specifically for sustainable urban transformation, but the approach could be broadly relevant). This allowed the participants to build problem solving capabilities.

The role of social learning is important to improve bottom-up adaptation. Reed *et al.* (2013) looked at the sustainable rural livelihoods framework but added social learning and evaluation of trade-offs. This was used in developing county context, so the value of the approach for developed countries needs to be evaluated. Joyce *et al.* (2013) used social learning to raise awareness, consider incentives, build networks, encourage experimentation and encourage flexibility in assets for rangelands in the USA.

New forms of inter- and trans-disciplinary approaches are required to integrate socio-technical perspectives on long term system innovation. Eames *et al.* (2013) involved a wide range of stakeholders in hindcasting and future visioning for urban retro-fitting using a range of actors including industry, academia, government, civil society and community organisations. The approach seems to be a fairly intensive in terms of considering alternative futures with different regimes (housing, non-domestic buildings, urban infrastructure), scales (building, neighbourhood, city region) and domains (energy, water, use of resources) in a participatory process. The process was designed to “open up” the governance and strategic navigation of urban sustainability, but there are useful insights and approaches for other applications.

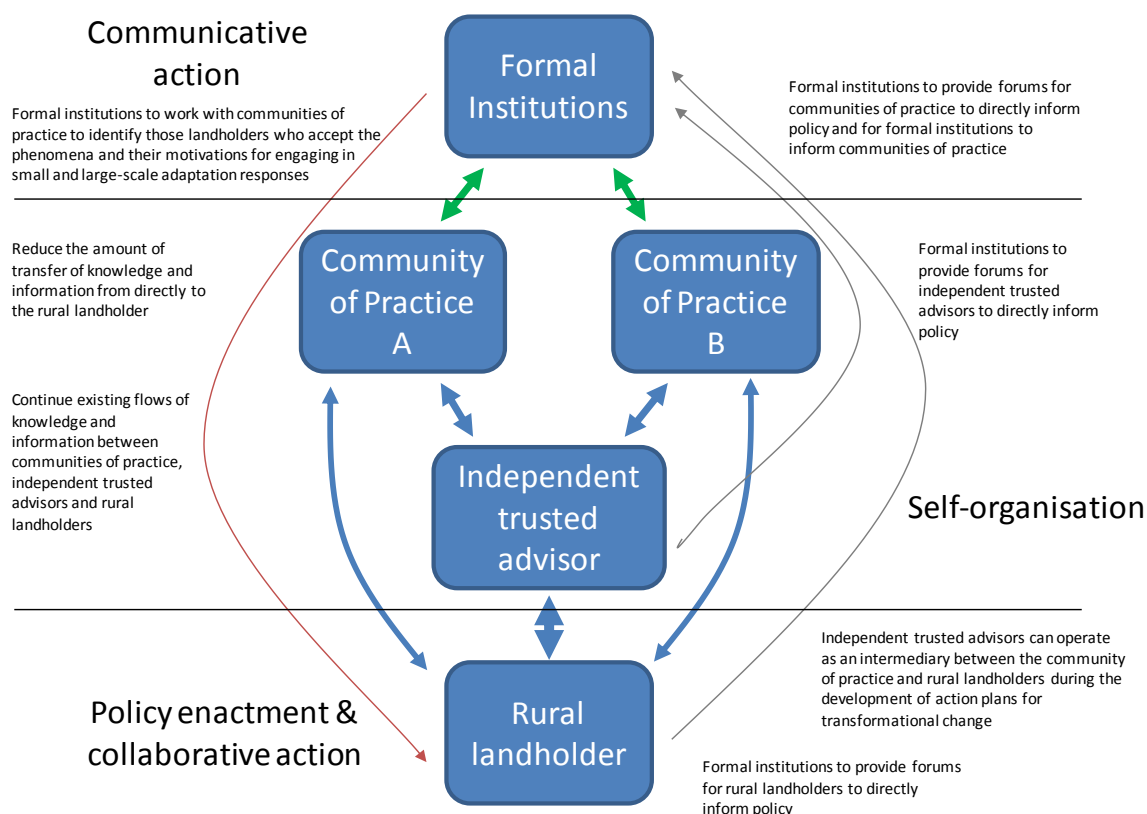
Webb *et al.* (2013) warns, however, that sufficient resources are required for communication and participatory approaches to clarify stakeholder values and beliefs. Furthermore, local and community knowledge needs to be supported to complement expert and scientific sources (Webb *et al.* 2013). Expert judgement can be built into assessments. Haasnoot *et al.* (2013) used expert judgement and scorecards to examine tradeoffs to examine deep uncertainties relating to climate change adaptation and sea level rise and flooding for the Netherlands. They incorporated this into a new planning paradigm termed Dynamic Adaptive Policy Pathway (Haasnoot *et al.* 2013).

A common element is to ensure strong and consistent leadership in all phases of the work, to facilitate problem-framing and project scoping (Webb *et al.* 2013). Problem-framing and project-scoping were significantly influenced, consciously or unconsciously, by the values, beliefs, roles, professional background and relative power relations of the initial leaders and project sponsors.

### **1.2.1 Case study of factors affecting landholder adaptation in South Australia**

Raymond and Robinson (2013) assessed the factors affecting rural landholders' adaptation to climate change using formal institutions and communities of practice. A

combination of formal institutions and communities of practice are required. Raymond and Robinson (2013) present a model (Figure 1) to transfer knowledge and information on climate change among formal institutions, communities of practice, trusted advisors and rural landholders to support the co-management of climate change across multiple groups. The framework is directly relevant to rural landholders (farmers) in Australia, but the principles could be adapted for other situations. The model is worth exploring further.



**Figure 1. Raymond & Robinson (2013) proposed this co-management model to support the transfer of climate change adaptation knowledge and information among formal institutions, communities of practice, independent trusted advisors and rural landholders (redrawn from Raymond and Robinson, 2013).**

Note. The width of the arrow reflects the desired level of transfer of climate change adaptation knowledge and information between the respective groups. Red arrows denote the knowledge and information transferred by formal institutions and blue arrows denote the knowledge and information transferred by communities of practice and their members, including independent trusted advisors. Green arrows represent the proposed two-way transfer of knowledge and information between formal institutions and communities of practice. Grey arrows represent the transfer of knowledge and information between rural landholders and formal institutions and independent trusted advisors and formal institutions.

## 1.3 UNDERSTANDING KEY DRIVERS OF TRANSITION

Understanding of key drivers of transition is necessary to consider potential intervention points (see sibling report Kuruppu & Jacobs 2014 “*Climate adaptation pathways*”:

*Resilience, Transition and Transformation*"). Joseph *et al.* (2013) used an historic assessment of the factors and processes that led to coastal communities in Central Java, Indonesia, to transition from traditional coastal activities to other livelihoods because of sea level rise. They used a range of methods to look at historical transitions including Participatory Rural Appraisals, historical timeline analysis, participatory discussions and socio-economic surveys. Many of these approaches would be suitable for the Australian context. However, there is an issue about studying past unplanned changes and trying to influence or plan future changes. What was observed in the past as important might not be important in the future.

## 1.4 MANAGING “CLIMATE CHANGE” VERSUS SPECIFIC EVENTS

Often the agenda should not be labelled as “climate change”, because this often leads the discussion away from the main issue and gets caught up in political or emotive arguments which often cannot be resolved. An alternate approach is to focus on specific events or issues that need not necessarily be labelled as “climate change”, and so can be achieved through other mechanisms. For example managing storm surges, heat waves. Bruzzone (2013) looked at flood control areas in Flanders, Belgium subject to sea level rise and flooding. Climate change and adaptation was not relevant at local levels. There was a clear danger that adaptation measures will never be realised, as priorities change and because of political imperatives. Adaptation is tightly bound to local processes and narratives, and the link is made through materiality. Joyce *et al.* (2013) talked about no regrets options. Implementation can be justified without emphasis on pending climate change.

## 1.5 EXAMINE ASSUMPTIONS

Some authors have suggested that the science of global change may need to change itself; that is, it needs to be more reflective about own assumptions and how to change (O’Brien 2012). An alternative model of social change involves a weakening of the contemporary rules of the game, a questioning of the status quo, and the introduction of more sustainable regimes into all domains of daily life.

## 2 CONSTRAINTS RECOGNISED BY THE ADAPTATION LITERATURE

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A suite of constraints to achieving climate adaptation have been recognised in scientific literature (Biesbroek *et al.* 2013; Measham *et al.* 2011). Within the context of the IPCC 5th assessment, a distinction is drawn between discrete constraints and dynamic constraints (Klein *et al.*, 2014). The first group refers to determinants of adaptation in the form of resources such as information and financial capital (Matasci *et al.* 2013). The second group refers to issues such as governance, cultural values and social priorities (Pasquini *et al.* 2013). The importance of this second group is emphasised by Adger *et al.* (2007) who noted that high levels of adaptive capacity in terms of resources do not necessarily translate into adaptation action and reductions in vulnerability to climate change. While important to distinguish between these two categories of constraints, it is important also to acknowledge that frequently they work together. For example, there may not be adequate institutional arrangements to secure the necessary resources to achieve adaptation in a particular context (Measham *et al.* 2011). Therefore it is important to recognise that adaptive capacity incorporates both resources and the ability to deploy them in pursuit of adaptation (Nelson *et al.* 2007).

### 2.1 LACK OF INFORMATION

Limited access to information concerning the vulnerability of municipalities to climate impacts has been a substantial constraint recognised in the literature (Mukheibir and Ziervogel 2007; Crabbé and Robin 2006). Due to insufficient detail about the likelihoods of impacts in given locations, scenarios have been used to assist climate adaptation planning, drawing on IPCC assessments, particularly at the national and state scale (Dessai *et al.* 2005). A key point is that the degree of information needed for adapting to climate change depends upon the type of response in focus. Moreover, it needs to resonate with the concerns of politicians, planners and managers, at the scale at which they make decisions (Amundsen *et al.* 2010).

### 2.2 INSTITUTIONAL LIMITATIONS

Another recognised constraint on the ability of local institutions to adapt to climate change concerns the policy framework in which local government operates. Like many jurisdictions around the world, in Australia local government does not have any constitutional basis, although this may change in the near future. Rather local governments are the delegated agents of State and Territory governments, which means they have limited ability to design their own policy frameworks for adaptation (Wild River 2006; Ivey *et al.* 2004). However, we have to be careful about the potential problem with the mismatch between current organisation roles and scale of adaptation issue and institutional support (Webb *et al.* 2013).

## 2.3 RESOURCE CONSTRAINTS

Local governance systems are often highly constrained in terms of their financial capacity, although this varies enormously from better resourced capital city councils through to poorly resourced rural councils (TCorp, 2013; Pini *et al.* 2007). Financial constraints also relate to the wide range of activities in which local governments are engaged. This lack of resources has been linked to reactive management of facilities and infrastructure, for which their lack of authority over and stressed resources can impact on effective life-cycle planning, favouring short-term technical fixes rather than long-term integrated approaches to addressing problems (Crabbé and Robin 2006; Brackertz and Kenley 2002).

## 2.4 COMPETING AGENDAS

The many and varied roles of local government are all competing for finite resources, often from higher levels of government with their own sets of priorities. For this reason, any organisation undertaking adaptation can't ignore the likelihood of political discord: climate adaptation represents only one area of priority amongst others, many of which may seem more tangible or imminent compared to the impacts of climate change which can seem distant in time and in space (Measham and Preston, 2012). The relative importance of climate adaptation is also influenced considerably by how the issue is framed. For example, to the extent that it is viewed as a public safety issue or a development issue, it may have greater resonance with decision makers. Generally, however, climate adaptation tends to be seen as an environmental issue, alongside such topics as pollution and water quality, with resources diluted amongst these various concerns (Keen *et al.* 2006; Measham *et al.* 2011; Critchley and Scott 2005).

## 3 OVERCOMING CONSTRAINTS TO ADAPTATION

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### 3.1 GOOD ADAPTATION PRINCIPLES

A recent NCCARF review identified the following principles of 'good adaptation' (Webb and Beh, 2013: 17-19) and largely follow the findings of this review:

1. Sustained and effective leadership
2. Effective stakeholder engagement
3. Maintaining a balance of social, economic, environmental and institutional objectives
4. Learning from experience of other adaptation initiatives
5. Following adaptive management approaches including evaluation and social learning
6. Explicit framing of adaptation issues agreed up front
7. Addressing multiple spatial and temporal scales together
8. Taking a systems approach to climate risks
9. Evaluating adaptation options most relevant to support decision making
10. Articulating a clear statement of adaptation vision
11. Carefully choosing appropriate methods for relevant issues

### 3.2 EXAMPLES OF WAYS TO OVERCOME BARRIERS

Adaptation is evolving quickly and several initiatives have been undertaken to overcome the constraints defined in the previous section. In seeking to overcome the multiple and interrelated barriers to adaptation, several important strategies have been put forward. Several of these involve coordination across different scales of governance. For example, local government planners have identified the need to work with surrounding local councils and private contractors to assess their vulnerability and meet their information needs (Taylor *et al.* 2013). This is consistent with the principles of enhancing regional cooperation and building shared understanding identified by Mukheibir *et al.* (2013).

Of particular interest is how to elevate climate adaptation from being seen as simply an environmental problem. Previously, local governments tended to assign responsibility for climate adaptation to the environment department of the respective organisation, rather than address it as a cross-sectoral issue (Measham *et al.* 2011). To overcome this 'silo' problem, two key factors have been noted by recent adaptation initiatives. Foremost amongst these is leadership. In successful initiatives in South Africa, elevating climate change to beyond the silo of the environment department has been the outcome of policy goal setting amongst local political leaders and senior managers (Measham *et al.* 2011). Inclusion of both types of leaders active in local government (political and administrative) is vital to ensuring goal setting and allocating resources to achieving those goals (Pasquini *et al.* 2014). The second factor was the impact of seeing the effects of failing to adapt to climate change at the local scale. Observing the impacts of climatic events often

as a result of natural disasters, which overwhelmed infrastructure based on previously observed climate extremes had the effect of galvanising support for climate adaptation albeit in the short term. In essence, these events conveyed a sense that climate change represents a genuine and costly risk to settlements, and that action is required despite the multiple competing priorities of government bodies (Pasquini *et al.* 2014).

## 4 EXAMPLES OF ADAPTATION PROJECTS IN NEW SOUTH WALES

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Several adaptation initiatives have taken place over the last decade or so in New South Wales and around Australia (Webb *et al.* 2013). Some of these have been specifically focused on New South Wales, while others have included representation from New South Wales within a broader study. There are four of these which are prominent importance for this review prepared for NSW OEH.

Of particular relevance to this literature review are:

- Hunter, Central and Lower North Coast Climate Change Risk Assessment and Adaptation Strategy (HCCREMS 2010)
- Sydney Coastal Councils Group Systems Approach to Regional Climate Change in Metropolises, (Smith *et al.* 2008; Preston *et al.* 2009)
- Australian Capital Region Vulnerability Scoping Study (Webb 2009).
- Integrated Assessment of Climate Change Impacts on Urban Settlements (IACCIUS) – ACT, Queanbeyan, Cooma (NSW), Bendigo (Victoria), Darwin (NT) (Li and Dovers 2011).

For the purposes of this review, we have excluded the pilot study conducted in South East NSW of the Integrated Regional Vulnerability Assessment conducted by NSW OEH (2012).

A summary of each of these initiatives is provided in the next section.

### 4.1 HUNTER, CENTRAL AND LOWER NORTH COAST CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION STRATEGY

This initiative developed a climate change risk assessment working in collaboration with the Greater Taree City Council. The purpose of the risk assessment was to explore the range climate change risks for the greater Taree area and prioritise those risks for the Council. The project considered all of the Councils activities that could be affected by climate change over current, medium (2050) and long term (2100) time horizons, using a qualitative risk evaluation framework. (e.g. likelihood and consequence scales). The outcome of the project was a set of priority risks and recommended actions. The risks are strongly related to the likely impacts of sea level rise in the greater Taree region. These have been summarised in Table 1, adapted and summarised from HCCREMS (2010).



**Table 1. Overview of risks and recommendations in Greater Taree Risk Assessment**

Risks	Recommendations
Increased damage to council buildings	<ul style="list-style-type: none"> <li>HCCREMS councils and LGSA jointly approach State Government to clarify natural disaster declarations and funding arrangements.</li> <li>HCCREMS councils seek advice from insurance agencies</li> <li>GTC Council should review asset base, service requirements and maintenance schedule</li> </ul>
Failure of stormwater infrastructure due to more intense rainfall	<ul style="list-style-type: none"> <li>HCCREMS councils to conduct modelling of rainfall intensities</li> <li>Develop regional guidelines for upgrading drainage design</li> <li>Regional capacity building for stormwater staff</li> <li>HCCREMS councils to seek funding from State and Federal governments to implement stormwater priorities</li> <li>CTC Council should revise local planning, stormwater and flood studies to integrate outcomes from regional modelling</li> </ul>
Flood damage to low lying transport corridors	<ul style="list-style-type: none"> <li>Incorporate climate adaptation into regional design of new roads and bridges based on extreme rainfall projections</li> <li>Upgrade vulnerable existing roads and bridges across region</li> <li>GTC Council to revise construction standards based on regional design changes</li> <li>GTC Council to seek professional training on climate change and asset planning</li> </ul>
Increased pollution and siltation of waterways	<ul style="list-style-type: none"> <li>Regional review of local, regional and State plans to ensure consistency across environmental objectives</li> <li>Establish regional water quality monitoring strategy</li> <li>GTC Council to develop management strategies for high risk septic systems</li> </ul>
Increased distribution of acid sulphate soils	<ul style="list-style-type: none"> <li>Region to conduct research into acid sulphate soils and climate change</li> </ul>
Carbon pricing effect on waste facilities	<ul style="list-style-type: none"> <li>Region to Lobby Australian Government to clarify reporting requirements</li> <li>Raise community awareness about front-end separation of waste across region</li> <li>HCCREMS councils to investigate ways to increase organic waste diversion from landfill</li> </ul>
Increased beach erosion	<ul style="list-style-type: none"> <li>HCCREMS councils to develop high resolution data sets for elevation and water depths</li> <li>HCCREMS councils and government agencies to collaborative prepare Smartline Mapping of all estuarine foreshores</li> <li>HCCREMS councils, State and federal governments to develop a decision support tool to prioritise coastal protection works and other management options</li> <li>HCCREMS councils to raise community awareness of coastal erosion processes.</li> <li>GTC Council to assess need for site specific modelling and prioritise protection works</li> </ul>
Uncertainty in decision making around coastal planning and development; Flood modelling and planning scheme fail to reflect changed inundation risk	<ul style="list-style-type: none"> <li>HCCREMS councils to develop high resolution data sets for elevation and water depths</li> <li>HCCREMS councils to lobby State Government to develop guidelines for integrating climate projections into coastal hazard models and management</li> <li>HCCREMS councils to work with LGSA to commission legal review of local government liability in context of climate change</li> <li>HCCREMS councils to work with State Government to develop protocols for land use planning in vulnerable areas</li> <li>HCCREMS councils to seek funding for capacity building on legalities of land use planning and climate change</li> <li>HCCREMS councils to prepare information for residents on how they are addressing climate change and coastal flooding</li> <li>GTC Council to undertake site specific flood modelling where existing flood</li> </ul>

management plans do not fully reflect the outcomes of rainfall projections

**Table 1 continued**

Risks	Recommendations
Traffic movement affected by flooding;  Isolation of vulnerable communities due to storms, flooding or bushfires	<ul style="list-style-type: none"> <li>HCCREMS councils, in conjunction with RTA and emergency service agencies should update local and regional traffic plans</li> <li>HCCREMS councils, with support of RTA should upgrade vulnerable roads and bridges</li> <li>HCCREMS councils in partnership with emergency management authorities should educate community about increased for floods</li> <li>GTC Council should identify adaptation strategies/works for vulnerable local infrastructure</li> </ul>
Council unable to meet demand for localised emergency response	<ul style="list-style-type: none"> <li>HCCREMS councils and regional emergency service agencies should consider multi-agency emergency preparedness exercises.</li> <li>Regional review of existing emergency response frameworks</li> <li>GTC Council should consider increased staff training in emergency management procedures</li> </ul>
Increased community anxiety and stress associated with extreme climate events	<ul style="list-style-type: none"> <li>Region to work with State Government to commission research into understanding risk perceptions</li> <li>GTC Council should consider implementing a community neighbourhood program</li> </ul>
Exhaustion of Council capacity to deliver regulatory and other critical services due to staff responding to emergencies; waste collection significantly disrupted by climate events	<ul style="list-style-type: none"> <li>GTC Council should implement a business continuity plan to provide strategies in the event of crises</li> </ul>
Legal liability, property damage and personal injury from falling council trees	<ul style="list-style-type: none"> <li>GTC Council in conjunction with LGSA to seek advice from insurance agencies</li> </ul>
Workplace health and safety for staff and contractors threatened as a result of increased frequency of heatwaves and severity of storms	<ul style="list-style-type: none"> <li>GTC Council to review risk management plan to ensure it adequately addresses risks to staff.</li> </ul>

Table notes: this summary has been synthesised from multiple tables published by HCCREMS. For full details of risks and recommendations refer to HCCREMS (2010). 'GTC Council' refers to Greater Taree City Council. 'Region' refers to the area defined by HCCREMS member councils.

### *Discussion of the case*

The case demonstrates that the way forward was found through working across regional groups of local councils, through a peak entity and accessing resources from higher levels of government. This approach is strongly consistent with theoretical discussions about how to overcome recognised barriers such as lack of resources, insufficient information and competing priorities for any individual council. So even though the local scale is central to experiencing and responding to climate impacts, adaptation actions are identified and coordinated at the regional scale and funded at the State or national scale (Taylor *et al.* 2003).

## 4.2 SYDNEY COASTAL COUNCILS GROUP SYSTEMS APPROACH TO REGIONAL CLIMATE CHANGE IN METROPOLISES

The Sydney Coastal Councils Adaptation Initiative was conducted from 2006 to 2008 to assist coastal municipalities in the Sydney basin to understand and respond to climate risks. The project was developed as a collaboration between the Sydney Coastal Councils Group (a peak body for 15 municipalities), and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). It is important to note that at the beginning of the project climate change denial was a dominant force in Australian politics, however this shifted during the course of the project, as reflected in a change of government at the federal level in 2007, partly due to increasing recognition of climate change. These national debates were echoed at the local and regional scale where, for example, storms and beach erosion were attributed to climate change. The case study area represented the coastal councils from Hornsby in the north to Sutherland in the south. The project team of 10 staff comprised professionals in environmental science, economics and human geography, and local government leaders and planning professionals. The project was conducted in three phases, which are described in the following sections.

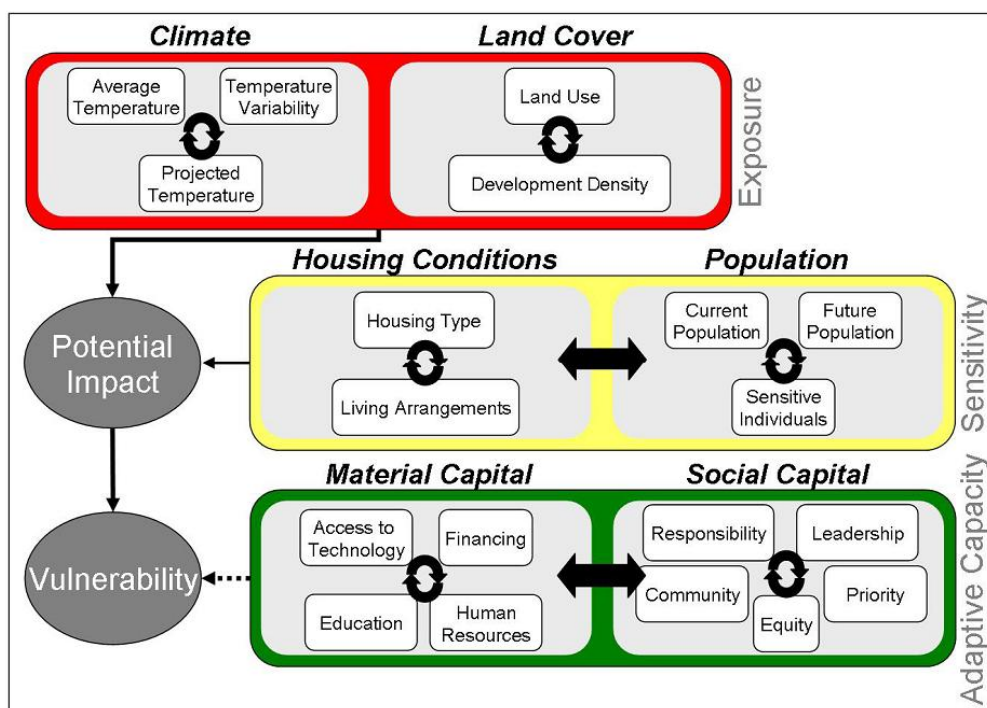
### 4.2.1 Phase 1: Mapping vulnerability

The first phase of the project involved assessing and mapping relative vulnerability to climate impacts across the 15 participating council areas. This was initially conducted as a desktop exercise and then presented to council representatives and staff for feedback, resulting in revisions to the assessment. The project adopted the Intergovernmental Panel on Climate Change (IPCC 2001) definition of vulnerability, namely, ‘... the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.’ This definition incorporates the principle of coping capacity. Increasingly, there is recognition that the potential for adverse effects from a hazard such as climate change is not simply a function of the hazard itself, but also the ability of societies (e.g. through institutions, technologies and policies) to respond to that hazard (Murphy 2012; Preston *et al.* 2008). In this project vulnerability was approached in terms of considering risk factors that represent susceptibility to harm. Five areas of potential climate impacts were considered for the vulnerability assessment

- Extreme heat and human health effects
- Sea-level rise and coastal hazards
- Extreme rainfall and urban stormwater management
- Bushfire
- Damage to natural ecosystems and assets

Vulnerability was conceptualised as having three components: exposure, sensitivity and adaptive capacity (Preston *et al.* 2008). For example, calculating vulnerability in relation to heat stress involved indicators of exposure (e.g. number of days above 30°C), indicators of sensitivity (e.g. the proportion of the population over 65) and indicators of adaptive capacity (e.g. household income). The relationship between these different components is

summarised in Figure 2. A full list of indicators used to calculate extreme heat vulnerability are presented in Table 2.



**Figure 2. Conceptual model of the vulnerability of human health to extreme heat events.**

Exposure (red) is driven by interactions between the climate system and the landscape. Sensitivity (yellow) is a function of the characteristics of the exposed population and the conditions in which they live. Adaptive capacity (green) is a function of the material and social capital that can address potential impacts and ameliorate (source Preston *et al.* 2008).

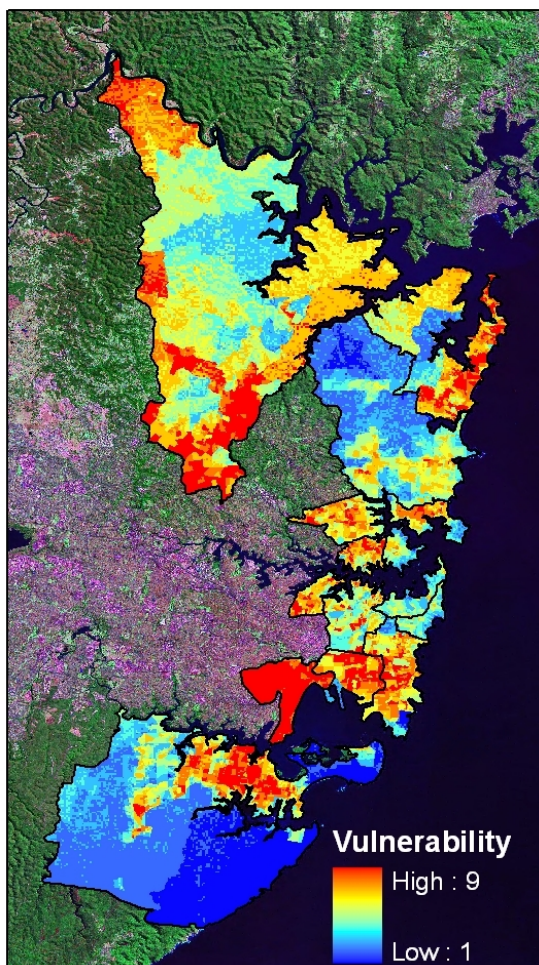
**Table 2. Vulnerability Indicators for Extreme Heat and Human Health Effects**

Exposure Indicators	Sensitivity Indicators	Adaptive Capacity Indicators
1) Present average January maximum temperature (BOM stations) 2) Present average January minimum temperature (BOM stations) 3) Present # Days > 30°C (BOM stations) 4) Projected change in average DJF maximum temperature in 2030 (25 km grid) 5) Land cover (14 m grid) 6) Population density (census districts) 7) Road density (5 km grid)	1) % population ≥ 65 years of age (census districts) 2) % population ≥ 65 years of age & living alone (census districts) 3) % population ≤ 4 years of age (census districts) 4) % of housing as multi-unit dwellings (census districts) 5) Projected population growth to 2019 (statistical local areas)	1) % population completing year 12 (census district) 2) % population that speaks language other than English (census district) 3) Median home loan repayment (census district) 4) % home ownership (census district) 5) Median household income (census district) 6) % households requiring financial assistance (Census district) 7) % population with internet access (census district) 8) Current ratios (local government areas) 9) Per capita business rates (local government areas) 10) Per capita residential rates (local government areas) 11) Per capita community service expenses (local government areas) 12) Per capita environment and health expenses (local government areas)



It is important to clarify that what the assessment process calculated was relative vulnerability, namely a ranking of how vulnerable each council was relative to the others (as compared with some hypothetical benchmark of vulnerability). Hence, the vulnerability scores that were generated do not necessarily translate into an absolute probability of an adverse event or impact. Nor do they provide an absolute measure of the harm that the community may suffer as a consequence of an event.

These indicators were integrated within a geographic information system to produce maps for each type of vulnerability by location, and one composite map which demonstrates net relative vulnerability across the study area (Figure 3). The research team compared their assumptions underpinning the calculations with those of SCCG member council staff, who confirmed that they seemed reasonable. For some threats, such as sea-level rise and bushfires, vulnerability maps generally agreed well with risk perceptions of council staff. For other threats, however, council staff often didn't have sufficient knowledge to form an opinion on the appropriateness of the maps. This suggested that councils were far more aware of and sensitive to risks for which they had direct management authority, historical experience, or for which there were vocal community concerns. The results of this phase pointed to a number of hotspots within the Sydney region that were considered relatively more at-risk to the effects of climate change than other locations. These included northwest and southern Hornsby Shire Council, eastern Pittwater Council, the area between Sydney Harbour and Botany Bay (particularly Rockdale and Botany Bay City Councils), as well as northern Sutherland Shire Council (Preston *et al.* 2008). However, the causes of this vulnerability varied depending on local context.



**Figure 3. Example of a map showing a composite of net vulnerability across the study region.**

Councils within the area were: Botany Bay, Hornsby, Leichhardt, Manly, Mosman, North Sydney, Pittwater, Randwick, Rockdale, Sutherland, Sydney, Warringah, Waverley, Willoughby and Woollahra (Preston *et al.* 2008).

This phase resulted in three key findings:

1. There was significant spatial variability across the SCCG region with respect to climate change vulnerability. The different classes of climate impacts varied from highly fragmented to concentrated in certain areas. This suggested the need to tailor responses to accommodate the unique challenges posed by different impacts across the area.
2. Demographic and socio-economic characteristics were equally relevant to biophysical hazards when determining the potential for harm.
3. The process of conducting the assessment was just as important as the outcome. Defining appropriate indicators of exposure, sensitivity and adaptive capacity and comparing them with council perspectives provided important insight and learning about the nature of vulnerability for the research team and project partners.

#### **4.2.2 Phase 2: Community engagement workshops: vulnerability analysis as dialogue**

Workshops were conducted with each of the 15 participating councils in the case study region to consider the results of the vulnerability mapping process and what this meant for each council. In addition to confronting the implications for each council area, the workshops focused on identifying opportunities and barriers for action. Across the 15 workshops a total of 257 individuals took part. The workshops were attended by a broad cross-section of roles within local government including elected councillors representing local constituents and council staff such as social planners, land-use planners, lawyers, engineers, senior managers, environmental officers and community engagement specialists (Smith *et al.* 2008a).

After reviewing the outputs from the vulnerability assessment, workshop participants created systems diagrams of key climate change drivers, impacts, and management responses specific to their location. The systems diagrams were used to assist councils to identify their priority climate issues, which were then discussed in small groups in terms of the barriers and opportunities to managing them. Many workshop participants were concerned about potential liabilities as a result of climate change and observed that current council plans and policies did not take climate change into account. Additionally, many participants were unclear as to the extent of local government statutory responsibilities in relation to climate change.

Following all the workshops, the research team gathered to group the broad range of concerns raised by participants into three cross-cutting issues. These were 1) community capacity and community expectations 2) infrastructure vulnerability and capacity, much of which is beyond the control of local governments 3) the nature of existing planning frameworks which limit council ability to respond to climate change. These findings highlighted the precarious position of municipalities in the governance network, in that they exist at the interface of bottom up, grassroots concerns of local communities as well as top down constraints imposed by higher levels of the state.

### 4.2.3 Phase 3: identifying barriers to action

To gain a deeper understanding of each of the cross-cutting issues that emerged from the workshops, a suite of three (sub) case studies was developed (Smith *et al.* 2008b). Three of the councils (Leichhardt, Mosman and Sutherland Shire) were selected for these more detailed studies. Thirty-three semi-structured interviews with representatives from these councils were conducted in April and May 2008. Participants consisted of a range of roles within councils including elected councillors, senior managers, middle managers, and operational staff. The interviews were recorded and transcribed verbatim. Interview responses were grouped into a series of themes coded in relation to:

- councils' current responsibilities for adapting to climate change;
- contextual, structural, procedural, and outcomes considerations with regards to the three regional cross-cutting barriers (community, planning and infrastructure);
- preferred council climate change adaptation roles and responsibilities;
- what councils needed to do differently to achieve their climate change adaptation goals; and
- respondents' expectations of this project.

In considering the responses, it was clear that the participating councils had already made significant progress in addressing climate change through greenhouse gas mitigation efforts. For some time, councils had been engaged in efforts to reduce emissions from council facilities and community constituents, driven by cost savings rather than concern for climate impacts. This reflected widespread awareness of climate change across the participating councils and the growing momentum for substantive actions to reduce emissions. Such efforts did not, however, address the issue of adapting to the effects of climate change. Local governments' more recent efforts on climate change adaptation illustrate the evolution of thinking and policy that manifests around emergent issues of public concern. Such efforts were tentative and ad hoc, comprised of a mixture of community engagement and geotechnical risk assessment. Interviews with council staff and councillors provided a clear indication that, generally, the participating councils would like to exercise greater leadership in ensuring communities are appropriately prepared.

Participants acknowledged responsibility for a range of climate related impacts including the need to revise details of storm water runoff and their approach to coastal inundation. Participants also noted major barriers to climate adaptation which propagate from the State of New South Wales (NSW) and Federal policy environment in which local government operates. At the time of the interviews, NSW State legislation and management frameworks relevant to local government activities assumed a stable climate. As a consequence, there was little ability for councils to manage climate risks within the frameworks that they use. This was exacerbated by the fact that other legislation placed restrictions on local government authority and decision-making with respect to building codes, rate increases, and limits on growth and development. Collectively, these issues hampered progressive action by local government with respect to climate adaptation.

Further adaptation barriers were found to stem from the organisational structures of local governments, resource availability and political priorities over decisions about climate risk in the context of other challenges faced by local government. Such barriers were a

function of both exogenous and endogenous factors. On one hand, councils expressed limited capacity to cope with a broad range of regulatory and service demands imposed through NSW State legislation given limited available resources including financial capital, technical information and expertise. On the other hand, it was also apparent that local government operations were structured around thematic 'silos', which compartmentalised expertise in core operational areas, and limited internal deliberation and diffusion of knowledge. Thus at the time of the interviews, some council sections that may well be vital to innovative approaches to managing climate risk didn't see it as part of their role. Our intention was to stimulate wider discussion of climate change vulnerability beyond the environmental section to other sections of council such as planners and engineers.

### *Discussion of case*

Although the first phase of the project was primarily a desktop assessment, the process of inviting feedback from council staff was crucial. Klinké and Renn (2002) argue that when risks are associated with uncertainty, scientific input is only the first step towards a wider process of deliberation. In practical terms, the approach taken here was similar to Mukheibir and Ziervogel (2007), who encouraged the involvement of stakeholders in vulnerability assessment to increase social acceptance of the outcome. Preston *et al.* (2011) note the importance of incorporating local knowledge and participation in both legitimising assessment results and facilitating learning. In theoretical terms, an inclusive approach to risk governance represents a normative assertion that integrating knowledge and values into risk assessment is best achieved by involving a wider set of actors whose respective knowledge leads to more effective, fair and morally acceptable outcomes (Renn and Schweizer 2009). This process led to the second phase of the study which focused on interpreting the implications of the mapping phase and framing local climate impacts through multiple detailed workshops employing systems thinking methods (Ison *et al.* 2007).

The purpose of the workshops was to extend the deliberation that emerged from the mapping process. In this way, the workshops represented epistemological discourse, or deliberation amongst experts (Klinké and Renn 2002). Importantly, experts need not be scientists, but anyone with specialist knowledge who can contribute towards the best available understanding of the phenomenon in question. Thus in our study, council engineers and bushfire management professionals contributed to the vulnerability assessment process. The workshops sparked wide debate over how to respond to the particular climate risks faced in specific locations. More widely, these workshops cemented an acknowledgement that climate change is a real issue that needs local attention, rather than a vague concern over an ambiguous threat. This is not to say that the vulnerability assessments were completely unambiguous (Preston *et al.* 2009; 2011). Rather, the uncertainty contained within them was more familiar and could be related to the daily business of local government on a case by case basis. For example, the workshops sparked quite specific conversations amongst engineers on how much bigger drains should be in order to cope with larger floods, and the types of knowledge relevant to making such a determination. In addition, the inclusion of social and economic metrics in the vulnerability assessment expanded councils' traditional geotechnical framings of vulnerability. In this regard, the second phase of the study endorsed the social learning process proposed by Tàbara *et al.* (2010) who clearly demonstrate that 'more knowledge' alone is a flawed approach to climate adaptation which depends on jointly defining and addressing problems.



## 4.3 AUSTRALIAN CAPITAL REGION VULNERABILITY SCOPING STUDY

The ACT and region climate change vulnerability and adaptation project completed a scoping study in 2009. The report, which was not publicly released, provided an overview of recent activity and knowledge to support climate change adaptation in the ACT and surrounding region, as well as recommendations for progressing adaptation in the region. In particular, the report recommended developing a vulnerability assessment as a credible first step towards an adaptation strategy, along the lines of the NSW Integrated Regional Vulnerability Assessment process, particularly given that the ACT is strongly connected to surrounding NSW regions. The remainder of the study provided an inventory of planned, ongoing and completed actions towards mitigation and adaptation, as well as further recommendations in the areas of community engagement, leadership and collaboration with NSW (Webb, 2009).

### *Discussion of the case*

This was a relatively small scale initiative which did not involve new original research or application. As such there are limited lessons which can be drawn in the context of this review. Essentially, the scoping study reinforces the lessons which have emerged from the other case studies. In particular, that vulnerability assessments are an important mechanism for advancing adaptation and that high levels of community engagement, leadership and collaboration with neighbours are recognised strategies for overcoming adaptation barriers. Since the 2009 scoping study, it is worth noting that the ACT Government (2012) developed specific guidelines for conducting vulnerability assessment in ACT in relation to infrastructure. These guidelines include recognition of the cross-boundary nature of climate adaptation challenges, particularly in the area of potable water storage and supply. However, in the final published guidelines there is no indication of input by NSW Government.

## 4.4 INTEGRATED ASSESSMENT OF CLIMATE CHANGE IMPACTS ON URBAN SETTLEMENTS

The Integrated Assessment of Climate Change Impacts on Urban Settlements (IACCIUS) project, which has been highly influential in developing subsequent vulnerability frameworks, included case studies of five towns around the country, including two in NSW: Queanbeyan and Cooma. The others were Canberra, Bendigo and Darwin (Li and Dovers 2011). The twin purposes of this project were (1) to develop and test a methodology for integrated assessment, and (2) investigate specific priority issues in each jurisdiction. The 'Integrated Assessment' method developed for the study was wider in scope, and less detailed in application, compared to the vulnerability assessments described in other cases (Preston *et al.* 2009).

The steps in the Integrated Assessment process are presented below. This has been simplified from Li and Dovers (2011, pp 293-294):

1. Establish the context as a 'whole of system' and 'whole of government' problem
2. Understand local climate change and climate variability
3. Conduct participatory risk analysis that
  - a) Teaches participants systems concepts and tools
  - b) Enables agreement of system boundaries
  - c) Identifies risks
  - d) Identifies constraining relationships between parts
  - e) Construct influence diagrams as a group
  - f) Prioritises parts of the system for in-depth analysis
4. Develop a system for communicating between researchers and stakeholders
5. Identify relevant policy context
6. Assess vulnerability for priority parts of the system using primary and secondary data to
  - a) Understand system components at risk (exposure)
  - b) Describe system sensitivities
  - c) Explore past adaptation actions and possible future strategies
  - d) Further systems analysis taking into account vulnerability findings
7. Participatory vulnerability assessment to further identify adaptation strategies and capacities to adapt including possible policy recommendations
8. Identify gaps in the analysis requiring further investigation and further data collection
9. Finalise analyses and disseminate to stakeholders
10. Stakeholders to take findings into account in policy making and implementation, and repeat any of the above steps as required.

In Cooma, local stakeholders prioritised climate change-driven threats to tourism from declining snow cover or increased bush fires. This was based on past events and likely future scenarios using local climate history and climate projections. It was difficult to project future visitation numbers in a useful fashion, therefore the project examined the impact of past poor snow and major fire seasons. Despite some data limitations, it was possible to indicate highly diverse impacts of poor seasons. Interviews with local tourism businesses revealed that some had already adapted to existing climate variability, and this was useful to prepare for future impacts. The project further showed that several strategies for dealing with future uncertainty were similar to recognised ways to support local economic development, including improved visitation data gathering, economic diversification and coordinated land use planning. The project revealed detailed understanding amongst local communities, industry associations and higher levels of government which may support coordinated adaptive strategies (Li and Dovers, 2011).

In Queanbeyan, rapid urban development and drought led to improved management of urban water run-off as a priority for adaptation. Remote sensing data was used to test for impervious surface variation. The results demonstrated a wide variation between newer and older areas of the town, and led to insights for managing stormwater through infrastructure and landscaping (Li and Dovers, 2011).

### *Discussion of the cases*

The Integrated Assessment process applied in Cooma and Queanbeyan was more flexible and therefore context-specific than other types of vulnerability assessments. It also had a greater focus on participation and enabling communities to develop their own

localised adaptation actions. With sufficient resourcing this approach would have considerable potential for other contexts. Although the method involves a high level of tailoring to local conditions, it is sufficiently robust and institutionally supported to inform subsequent IRVA applications in multiple NSW regions.

## 5 CHALLENGES IN MONITORING AND ASSESSING ADAPTATION

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The major problem in understanding adaptation and of devising and implementing adaptation strategies has been the difficulty in assessing their success. Bours *et al.* (2013) identified 12 issues that make monitoring and evaluation of adaptation problematical:

1. Adaptation is not an objective or end point and therefore has no clear signal that an adaptation program is 'successful'. Rather it is a process of continual adjustment which should enable specific socio-economic or environmental goals to be achieved despite a changing climate context.
2. Long timeframes for climate changes to manifest means that there can be significant time lags between adaptation interventions and the evaluation of measurable outcomes.
3. Uncertainties are inherent when implementing climate change adaptation interventions because future social and political priorities are unpredictable and will have profound influence on adaptation needs. The drivers of social and political change that affect social vulnerability may be unrelated to changes in climate.
4. Measuring avoided impacts is difficult especially when coupled to long timeframes. It may require establishing a counterfactual case (i.e. what would have happened in the absence of an intervention). In the case of adaptation to improve disaster management, how can success be measured if no disaster occurs during the monitoring period.
5. Diversity of key concepts and definitions. There are important, and sometimes subtle, distinctions between various terms, such as vulnerability, adaptation and resilience that are used by government agencies, NGOs and the community, which influence what is being evaluated.
6. Tracking a 'moving target'. The dynamic nature of natural and socio-ecological means that it is difficult to establish a fixed baseline from which to measure achievements. With overall conditions deteriorating or in flux under a changing climate the baseline itself may shift.
7. Climate change is global – but adaptation is local and should reflect conditions in situ, whether on a national, sub-national, or local scale and will likely vary radically from place to place. Monitoring and evaluation (M&E) frameworks will be required to operate at multiple scales in order to capture the factors which shape adaptation success and must accommodate a range of diverse influences including local cultural practices as well as national or regional governance structures.
8. Adaptation spans multiple scales and sectors. One consequence of this is that the kind of data that is useful for global policy and comparative research is either difficult to come by or simply not very relevant to evaluating smaller-scale initiatives – and vice versa. The myriad of ways to address 'vulnerability' or 'adaptive capacity' does not lend itself to a unified M&E framework.
9. Assessing attribution versus contribution. Government agencies seek to demonstrate that they have brought about a specific, attributable change as a result of investment in policy or programs. Doing so demonstrates accountability for government expenditure. However, adaptation defies simple cause and effect analyses because its complexity makes impossible untangling the range of interconnected factors that shape a long-term impact or outcome (for example, Brown *et al.* 2012, Jacobs and Brown 2014).

10. No one set of indicators or M&E approaches is applicable to all contexts making calls for universal, top-down indicators of climate change adaptation problematical. Unlike mitigation, which lends itself to global measures, adaptation is a process fitted to divergent contexts rather than an outcome of specific intervention. Hence the focus on assessing adaptive capacity, i.e. identifying a set of conditions that facilitate adaptation, rather than adaptation per se (for example, Jacobs *et al.*, 2014).
11. Causing harm: the ‘maladaptation’ problem. Intervention to reduce vulnerability to a climate hazard at one scale or for one community can cause harmful, unintended consequences for other communities or at wider scales. The uncertainty surrounding the outcomes of intervention can make maladaptation difficult to avoid.
12. Conflicting purposes and fit: when ‘sustainable development’ and adaptation are not inter-changeable. While the rhetoric of development in Australia is currently focused on economic development rather than of sustainability, there is a tendency for climate change adaptation and sustainability to be seen as synonymous. There is likely to be overlap between adaptation and sustainability practice but the two are not synonymous and interventions which focus on one may not necessarily contribute to the other.

## 5.1 HOW CAN ADAPTATION BE PROMOTED?

Climate change has recently been elevated into a new class of problems termed ‘superwicked’ with the following characteristics (Levin *et al.* 2012):

- time is running out;
- those who cause the problem also seek to provide a solution;
- the central authority needed to address it is weak or non-existent; and, partly as a result,
- policy responses discount the future irrationally.

These four features combine to create a policy-making “tragedy” where traditional analytical techniques are ill equipped to identify solutions, even when it is well recognized that actions must take place soon to avoid catastrophic future impacts (Levin *et al.* 2012).

For climate change adaptation, a lack of central authority ensures a general lack of strong policy instruments to ‘enforce’ adaptation responses through planning and implementation. Given the 12 constraints on successful adaptation, it is doubtful that strong policy options would work in any case and may likely do more harm than good.

## 5.2 AN ALTERNATIVE APPROACH

An alternative approach is to look to weak policy instruments that encourage flexible planning, local consultation and incorporation of local context coupled with institutional support at higher scales of governance. Regional areas in NSW, albeit at a different scale, could draw considerable lessons from approaches developed in the European Union. In the EU, a governance model called the Open Method of Co-ordination (OMC) has evolved

where ‘soft’ coordination among EU member states on social and employment policy is combined with mutual monitoring of policy implementation. The OMC has been likened to a peer review process (Schafer 2006a). In this case national governments are enabled to reach agreement on goals without having to fear the consequences allowing discretion among member states to choose among a variety of policy approaches and options (Schafer 2006b).

The Lisbon European Council defined the core elements of the OMC as:

- fixing guidelines for the Union combined with specific timetables for achieving the goals set in the short, medium and long term;
- establishing, where appropriate, quantitative and qualitative indicators and benchmarks against the best in the world, and tailored to the needs of different member states and sectors as a means of comparing best practice;
- translating these European guidelines into national and regional policies by setting specific targets and adopting measures, taking into account national and regional differences;
- periodic monitoring, evaluation and peer review, organized as mutual learning processes.

## 5.3 SOME PROMISING POLICY TOOLS

Drawing on the experience of the EU in developing ‘soft’ policy options and some recent literature on innovative methods of promoting adaptation to climate change we suggest three approaches that show promise as tools to inform climate adaptation policy.

### 5.3.1 Positive path dependency and adaption pathways

Path dependency is usually considered as a negative characteristic of systems whereby certain conditions, be they policies, technologies, and institutions, endure despite the presence of other seemingly more appropriate or logical alternatives. However, Levin *et al.* (2012) have identified the creation of positive path dependency as a potential strategy for dealing with super wickedness. They argue that path-dependent policy interventions can ‘orient policy analysis toward understanding how to trigger sticky interventions that, through progressive incremental trajectories, entrench support over time’ for climate change adaptation while expanding the populations they cover.

An adaptation pathways approach (Smith *et al.* 2011) applies best available knowledge to achieve progressive, staged decision-making while keeping the broadest range of options open to chart a pathway that is responsive flexible with respect to changing circumstances over time. Such an approach allows regional actors to consider interactions between major adaptation actions that are likely to have overlapping timeframes (many available concurrently).

Creation of positive path dependency guided by the identification of flexible adaptive pathways could offers assistance to regional policy makers struggling with often conflicting perspectives of sector-based adaptation planning.

### 5.3.2 Benchmarking

Huggins (2010) argues that for regional policymaking, benchmarking forms part of processes concerned with learning by comparing, whereby regions seek to measure the performance, activities and policies of their competitors. Benchmarking consists of co-ordination through goal-setting linking the performance of co-operating parties – monitoring – to discussions of how to improve operations in light of this performance (learning), i.e. an adaptive management approach. Huggins notes several issues that need to be overcome for benchmarking exercises to be successful:

- The difficulty in maintaining up-to-date intelligence to inform relevant policymaking in a globalised environment of knowledge production;
- Long time lags at regional scale compared with national exercises; and,
- The need for financial and intellectual resources in the development of benchmarking exercises that can lead to ‘a benchmarking divide between core and peripheral regions’.

**Table 3. Summary of types of regional benchmarking and regional benchmarkers (Huggins 2010).**

		Types of Regional Benchmarkers		
		Independent Benchmarkers	Single Region Benchmarkers	Multi Region Benchmarkers
Types of Regional Benchmarking	Performance Benchmarking	Metrics based comparison of characteristics, undertaken by regionally external organisations	Metrics based on comparison of characteristics, undertaken by authorities/stakeholders representing one region	Metrics based comparison of characteristics, undertaken by authorities/stakeholders representing more than one region
	Process Benchmarking	Structures and systems comparison of practices, undertaken by regionally external organisations	Structures and systems comparison of practices, undertaken by authorities/stakeholders representing one region	Structures and systems comparison of practices undertaken by authorities/stakeholders representing more than one region
	Policy Benchmarking	Comparison of the public policies influencing processes and performance, undertaken by regionally external organisations	Comparison of the public policies influencing processes and performance, undertaken by authorities/stakeholders representing one region	Comparison of the public policies influencing processes and performance, undertaken by authorities/stakeholders representing more than one region

### 5.3.3 Functional regulatory spaces

A Functional Regulatory Space (FRS) is defined as a regulatory space, which politically emerges in order to tackle, support or solve problems concerning several policy sectors in different institutional territories and at different levels of government (Varone *et al.* 2013). An FRS is defined as a new or alternative regulatory space considered functionally appropriate, within which it becomes possible to tackle new types of problems that cut



across various socioeconomic sectors as well as institutional territories and government levels. FRS is designed to integrate three established policy theories that focused on 'boundary-spanning regimes', 'territorial institutionalism' or multi-level governance. FRS implies a redefinition of the hierarchical relationships between policy sectors, new geographical perimeters of the political regulation; and, a redistribution of competencies between levels of government. FRS has been applied in Europe to the management of trans-boundary river catchments and to the organisation of European aviation air space. The major impediment to the use of FRS in NSW is that it requires that the superwicked problem is politically recognised by public and private stakeholders, who agree on the necessity of specific State intervention in order to solve it. This condition is yet to be achieved in Australia.



## 6 CONCLUSION

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When considering the overall literature on adaptation to date, most of this literature is concerned with understanding the challenges associated with achieving adaptation. A smaller proportion of this literature is concerned with how to overcome those challenges, and an even smaller proportion of that literature is concerned with examples of actually implementing adaptation. In part this is due to the slow timeframes of the publication process by which actual cases are written up and published: However, it also reflects the fact that there is no simple formula to achieving adaptation. It is a slow and difficult process with limited examples of success. Amongst those examples reflected in the literature, most adaptation responses are focused on embedding adaptation into planning frameworks, updating design principles for infrastructure and strategies for managing more severe climate impacts such as floods and bushfires.

In terms of future directions, it is important to recognise that there may be other forms of adaptation which are not currently captured in documents and therefore beyond the scope of this review. These could include actions taken by individuals or community groups which have not been documented to date. It will be important to look for these in the next phase of this project.

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